Chagrin River Watershed Partners, Inc.

Collaborative Learning Group Meeting

National Estuarine Research Reserve System

Science Collaboration Grant

January 26, 2012

Project Partners

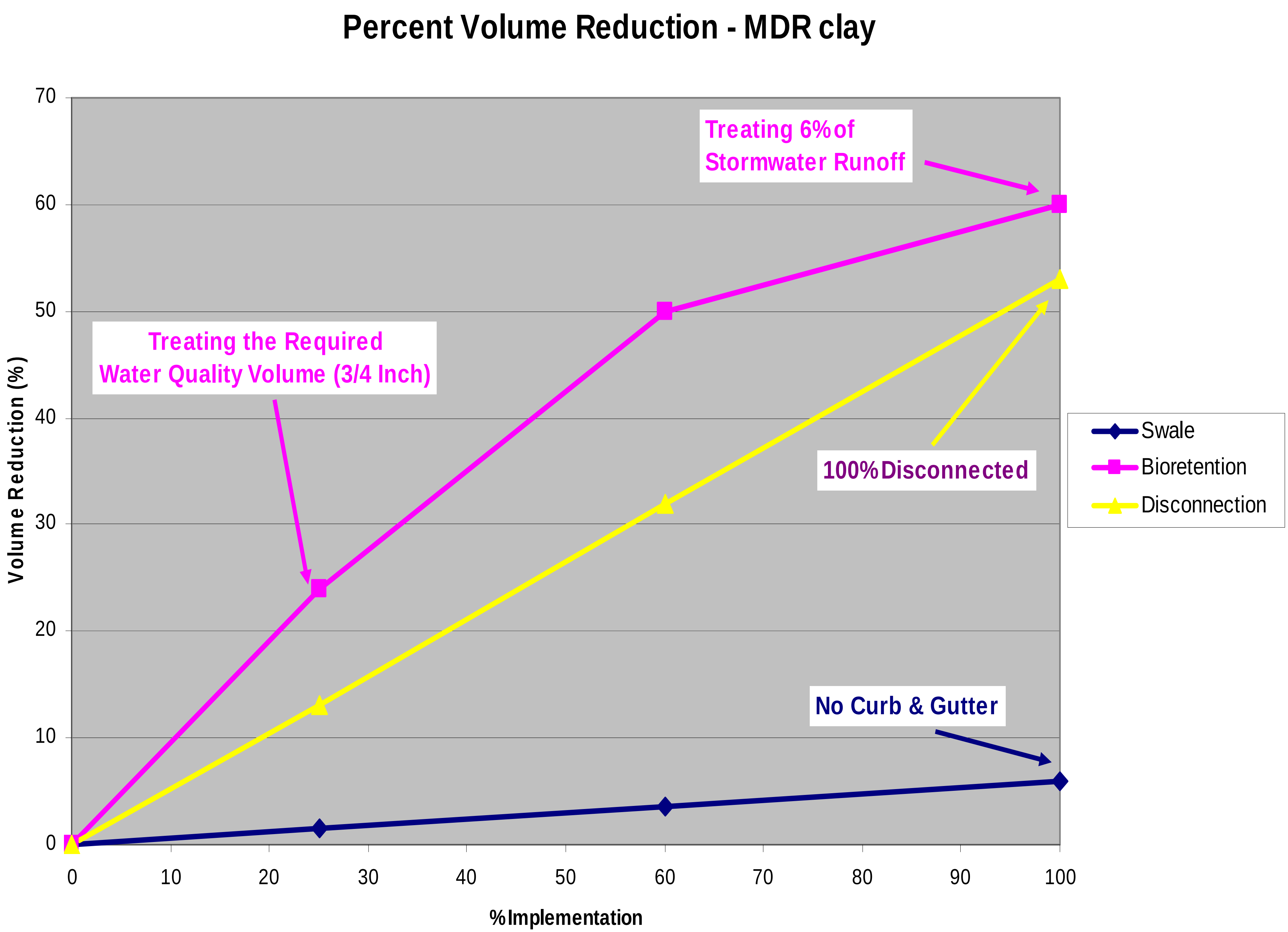
- **Chagrin River Watershed Partners, Inc.**
- **Old Woman Creek National Estuarine Research Reserve**
- **Ohio Department of Natural Resources, Division of Soil and Water Resources**
- **Firelands Area Coastal Tributaries/Erie SWCD**

Today's Collaboration Meeting Objectives

- Project participant introductions
- Review overall project
- Identify Best Management Practice (BMP) types to monitor and model
- Present and discuss potential monitoring sites

How Did We Get Here?

- Model Regulations for Comprehensive Stormwater Management
- USEPA Grant to Demonstrate Low Impact Development (LID) Projects
  - Constructed and monitored demonstration projects
- Lack of widespread LID adoption
  - Technical and social barriers still exist
- Modeling work with ODNR
  - WinSLAMM modeling showed site-scale annual runoff volume from a few percent to over 50%
  - Impervious area disconnection and bioretention show the most promise for residential areas
  - Pervious pavement and bioretention show the most promise for commercial sites.
- Applied for NERR-SC grant in 2010



Percent Volume Reduction - MDR clay
Volume Reduction (%)
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
% Implementation
Treating 6% of
Stormwater Runoff
Treating the Required
Water Quality Volume (3/4 Inch)
100% Disconnected
No Curb & Gutter
Swale
Bioretention
Disconnection

2009: Runoff reduction = 33%
2010: Runoff reduction = 60%

National Estuarine Research Reserve (NERR) System Science Collaborative

- NOAA Funds administered by the University of New Hampshire
- Science-based research
- Address local coastal management problems.
- Researchers and intended users work together.

CRWP NERR Science Collaborative Project

Modeling peak discharge and runoff reduction using local case studies and provide training on methods and results.

- Quantify BMP specific and site level hydrology for local soil and climate characteristics.
  - Site Characterization: Test in situ soil conditions
- Design of 2-3 innovative stormwater BMPs
- Monitoring 6 innovative stormwater BMPs
- Modeling under current and future precipitation regimes
- Develop Implementation Tools

Project Structure

1. **Project Leads**: Coordinating and shepherding project
   - Amy Brennan (technical and principal investigator)
   - Heather Elmer (collaboration)
   - Jay Dorsey (applied science)

2. **Collaborative Learning Group (CLG)**: Ground-truthing, advising, representing needs of intended users

Overview of Collaborative Research

Standard Research	Collaborative Research
Researchers identify a subject of interest	End users articulate a need
Researcher selects a research question	
	Test / refine with end users: *Will the answer to this question be useful?*
Researcher plans activities & who will do them	
	End users give feedback, refine, spread the word: *How could this be improved?*
Researchers carry out work and draft results	
	Ask questions, advise on how to share: *What else is needed to explain this well?*
Researchers produce final product, publish	
	Work translated for users, shared by team and others: *How do we share this so it is used in the real world?*

Collaborative Learning Group (CLG) Role

- Initial Input: Assessment Interviews
- Provide input on location, design, and modeling of BMP demonstration projects.
- Feedback on initial research results and approach for design guidance and tools
- Test stormwater tools and training

CLG Membership

Three Major Research Components

1. Monitoring
2. Modeling
3. Tools and Guidance

1. Monitoring

Acquire additional data to populate the models

- Review available guidance and research on BMP monitoring
- Provide design guidance on 2-3 sites
- Work with USGS to develop monitoring plan/protocols
- Hydrology only
- Characterize site conditions
- CLG Role:
  - Select types of BMPs to monitor
  - Establish criteria
  - Provide input on site selection

2. Modeling

Accurately quantify runoff volume and peak discharge of BMPs under current and future local conditions

- Review and summarize available research and data
- Identify and evaluate modeling tools that quantify runoff volume and peak discharge
  - SWMM, WinSLAMM, TR-20/SCS CN, P8, DRAINMOD, Runoff Reduction Method, Recarga, LID Quicksheet, HyPer Tool, SELECT, SUSTAIN
- CLG Role:
  - Provide guidance on model selection
  - Review model inputs and early results
- A smaller focus group to discuss modeling details will be convened.

3. Tools and Guidance

Provide usable tools that facilitate implementation

- Ohio specific guidance on:
  - Site characterization
  - BMP design to facilitate monitoring
  - Easy to use tools for evaluating BMP design and performance
  - Construction, cost, operation, and maintenance of BMPs, including updates to Ohio Rainwater and Land Development Manual
  - Model local codes
  - Recommendations for stormwater utility credit programs and watershed specific permits
- CLG Role:
  - Give feedback on key audience needs
  - Review and test draft tools
  - Connect project results with stormwater colleagues

	Year 1	Year 2	Year 3
Modeling	Develop scenarios, select models, calibrate models	Validate models, add precipitation data, test SWMM model	Test model, have working model
Tools	Review model codes	Draft tools	Produce user friendly tools, model regs, recommendations
BMP Selection & Monitoring	Select sites & contractor, start collecting data at 2 sites	Collect data at 6 sites	Fold data into tools and models.
Collaboration	Assessment, convene CLG, quarterly CLG meetings	Quarterly CLG meetings, advise on tools, focus groups	Test models and trainings, trainings, do outreach
Project Management	Financial management, track lessons learned, annual review	Annual review, track lessons learned	Track lessons learned, final project review
Other	Scope economic needs	Compile economic data on BMPs	Create flood/hazard cost benefit analysis

Ohio Lake Erie Stormwater Assessment

- 18 interviewees, anonymous, 30-60 minutes
- Findings to be drafted into a memo
- Quick overview (teaser!)
  - Comfort with data sources varied, most for state level agencies, universities and CRWP
  - Data should be collected close to home, but lessons drawn from any similar soils and climate
  - Requests: to quantify benefits of LID, for standards across the state, for flexibility, for real life examples, for audience-specific trainings

Assessment, cont.

- What is working well now?
  - Some new technologies
  - Some areas advance, especially in urban areas
  - Some good trainings
  - Some early adopters & innovation
  - Increasing collaboration
  - More conservation and compact development

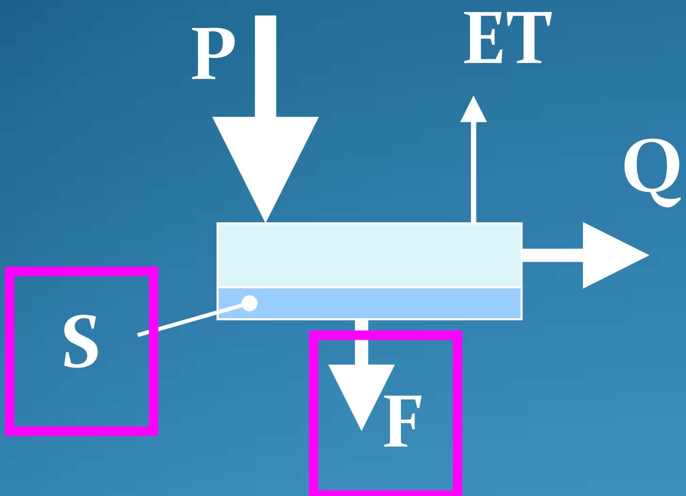
Assessment, cont.

- What could be working better?
  - Need more effectiveness and cost data
  - Need more info on and credit for infiltration
  - Some distrust of new solutions
  - Want standard reglations and expectations (OH-wide)
  - Some see stormwater management as a burden, not a value for our homes and communities
  - Local codes need to support innovative approaches
  - More coordination
  - Education of many groups, to ask for the best thing and maintain it correctly

Best Management Practice Overview

Types of BMPs

Essential BMPs to Monitor and Model



P – Precipitation (Rainfall & Snowmelt)

ET – Evaporation & Transpiration

S – Temporary Storage

F – Infiltration

Q - Runoff

$$Q = P - \boxed{dS} - ET - \boxed{F}$$

Future of Stormwater Management

- **States with Stormwater Volume Reduction/Infiltration/Recharge Requirements**
  - Maryland
  - Massachusetts
  - Michigan
  - Minnesota
  - New Jersey
  - New York
  - North Carolina
  - Pennsylvania
  - Tennessee
  - Virginia
  - West Virginia
  - Wisconsin
  - California
  - Oregon
  - Washington

- **In Ohio…**
  - Darby Stormwater Permit requires groundwater recharge
  - Chagrin and Grand River Stormwater Permits (Runoff Reduction Method under consideration)

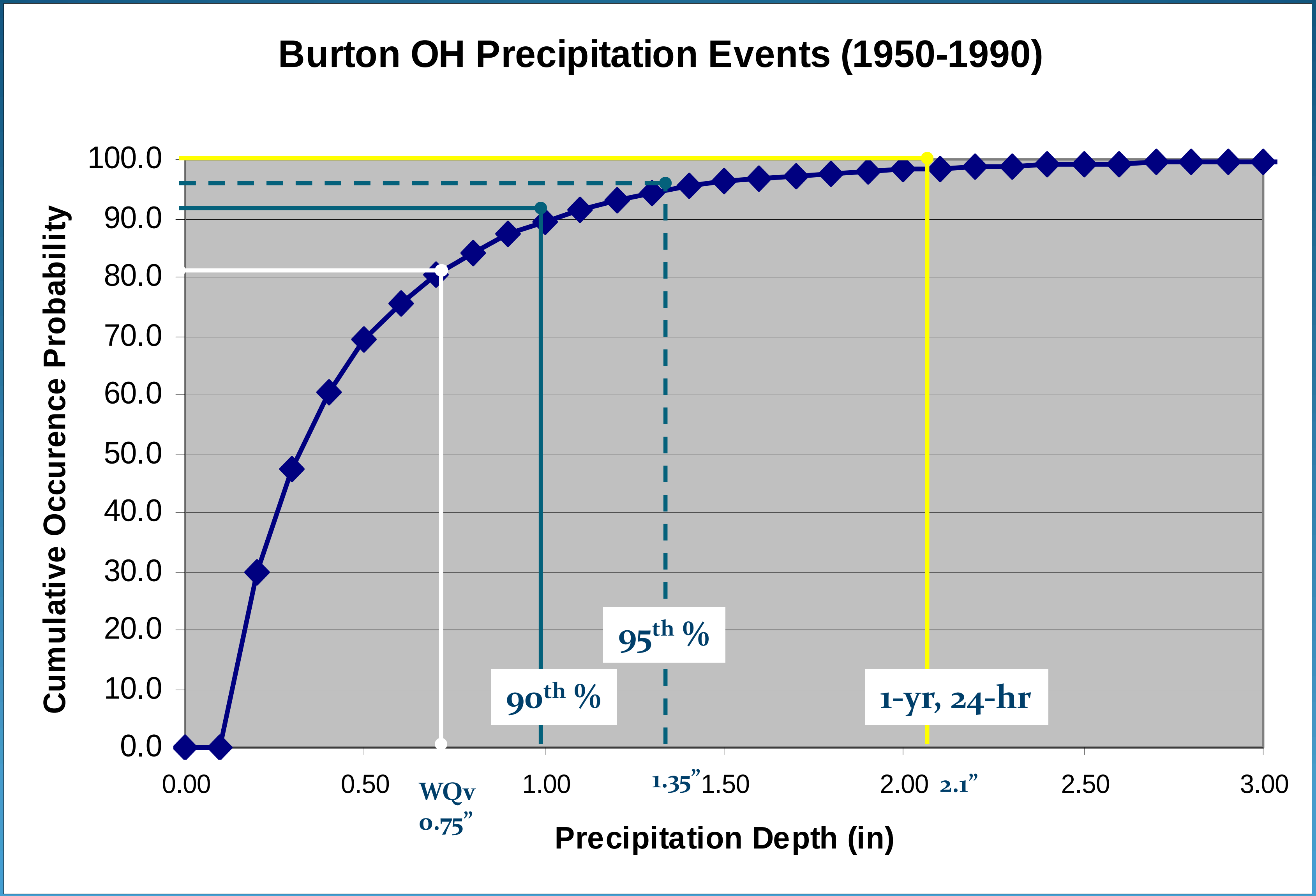
Further discussion of this topic at future CLG Meeting

Components Required for a Runoff Reduction Approach

- Target Retention (or Treatment) Volume
- Runoff Volume Accounting
- Peak Discharge Accounting
- BMP Toolbox

- Currently Ohio does not require a volume reduction standard statewide.
- Peak Discharge is a <u>local</u> requirement.
- This project will provide research to determine the role and potential of different BMPs to treat/infiltrate these volumes.

Ohio's WQv & other Notable "Events"



Potential BMPs to Monitor and Model

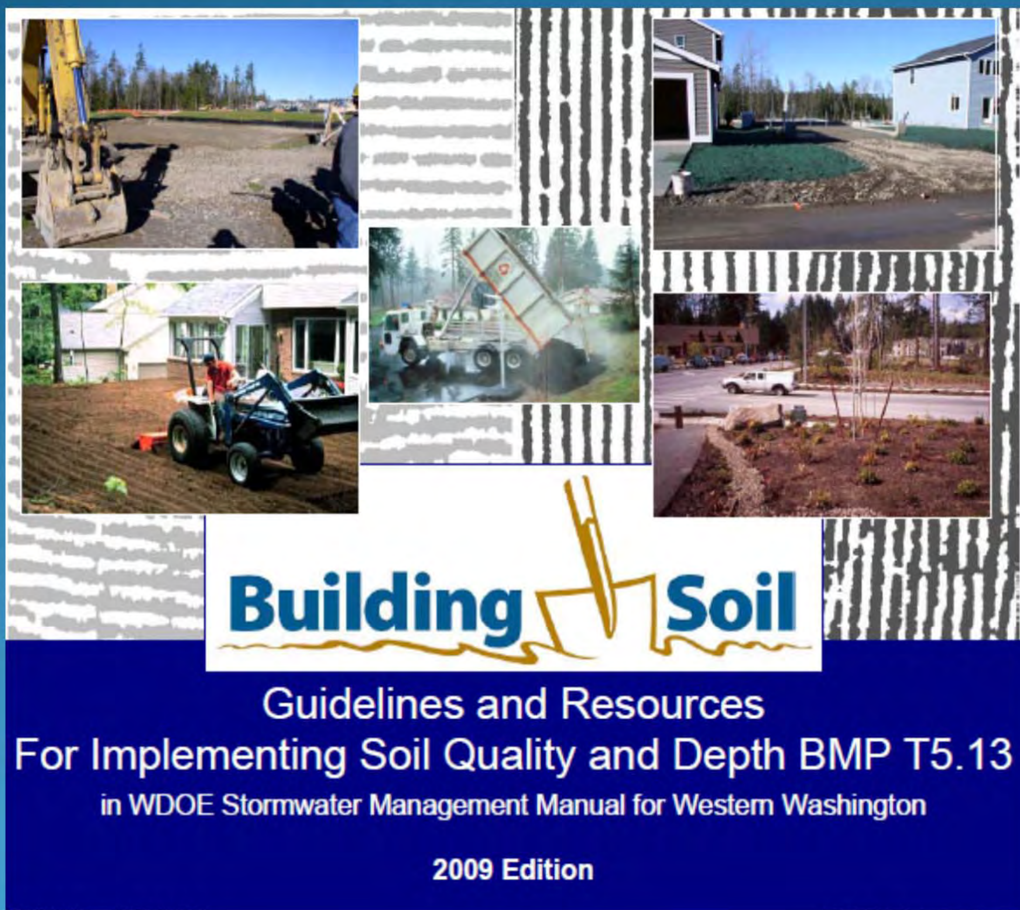
1. Soil quality preservation/renovation
2. Disconnection
3. Grassed/vegetated filter strips
4. Water quality swales (several variations)
5. Green roofs
6. Bioretention (including dry swales and tree boxes)
7. Pervious pavements
8. Underground detention/retention (with and without infiltration)
9. Dry detention (retention) basins
10. Infiltration (retention) basins and trenches
11. Wet ponds and wetland basins
12. Subsurface gravel wetlands
13. Cisterns/rainwater harvesting
14. Others?

1. Soil Quality Preservation/Renovation

- Maintaining or recovering the function of site soil
- Treatment mechanism – infiltration/retention, runoff volume reduction
- How well it works?
  - Retention potential – very high
  - Peak attenuation – high
- How much is known about the hydrologic performance of this BMP – medium
- What else do we need to know for modeling? Need real world infiltration, rainfall-runoff data, runon-runoff data




1. Soil Renovation



2. Impervious Area Disconnection

- Overland flow between source area and sewer system
- Treatment mechanism – infiltration/retention, runoff volume reduction
- How well it works?
  - Retention potential – high
  - Peak attenuation – very high
- How much is known about the hydrologic performance of this BMP – low/medium
- What else do we need to know for modeling? Need “real world” data

2. Impervious Area Disconnection

2. Impervious Area Disconnection

3. Grassed/Vegetated Filter Strip

- Overland flow between source area and sewer system
- Treatment mechanism – infiltration/retention, runoff volume reduction
- How well it works?
  - Retention potential – high
  - Peak attenuation – high
- How much is known about the hydrologic performance of this BMP – low
- What else do we need to know for modeling? Need "real world" data, design guidance for enhanced performance

3. Grassed/Vegetated Filter Strip

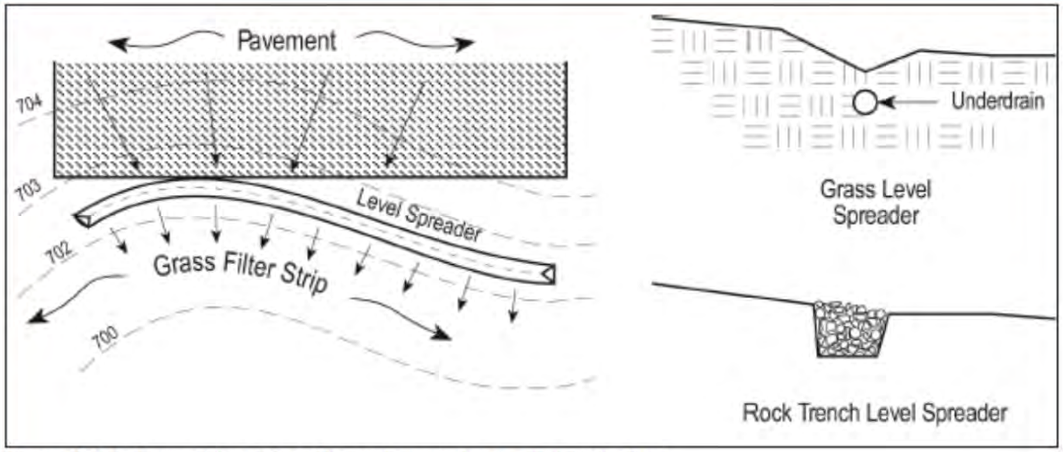
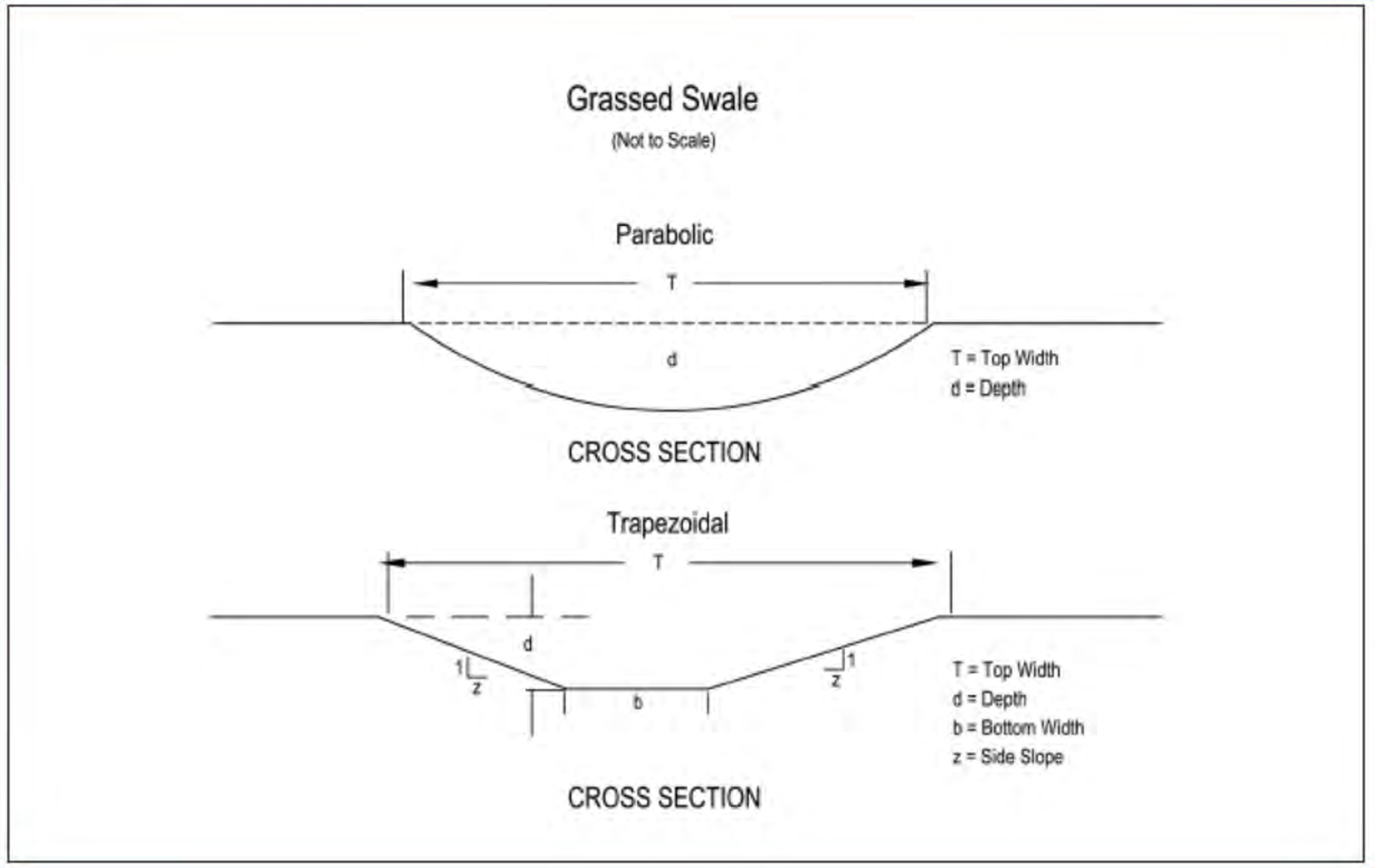


Figure 2.9.2 Grass filter strip with level spreader to distribute flow

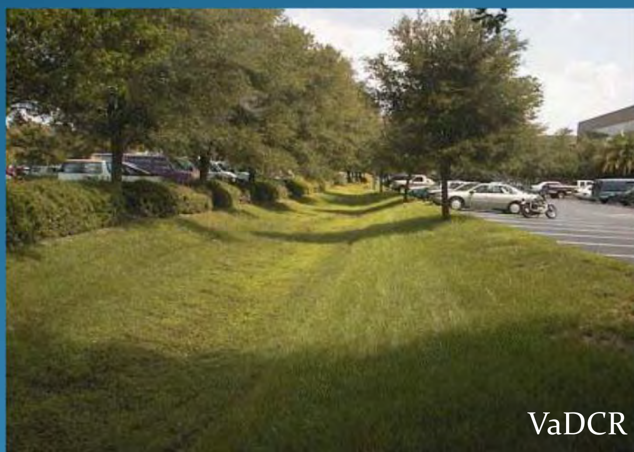
4. Swales (Vegetated Channels)

- Open/vegetated conveyance system to collect and convey runoff
- Treatment mechanism – filtration, little to medium infiltration/retention based on design
- How well it works?
  - Retention potential – low to medium
  - Peak attenuation – medium to high
- How much is known about the hydrologic performance of this BMP – medium to high
- What else do we need to know for modeling? More “real world” data, design guidance for enhanced performance

4. Swales (Vegetated Channels)



4. Swales (Vegetated Channels)



5. Green Roofs

- "Soil media", usually with plants, on roof tops
- Treatment mechanism – filtration, infiltration/retention, evapotranspiration
- How well it works?
  - Retention potential – medium to high
  - Peak attenuation – low
- How much is known about the hydrologic performance of this BMP – medium to high
- What else do we need to know for modeling? design guidance based on research

5. Green Roofs

6. Bioretention
Includes Tree Planters and Dry Swales

- Deep engineered soil media with plants and underdrain
- Treatment mechanism – sedimentation, filtration, biologically-mediated processes, infiltration/retention, evapotranspiration
- How well it works?
  - Retention potential – high to very high
  - Peak attenuation – medium to high
- How much is known about the hydrologic performance of this BMP – medium to high
- What else do we need to know for modeling? Ohio data

6. Bioretention

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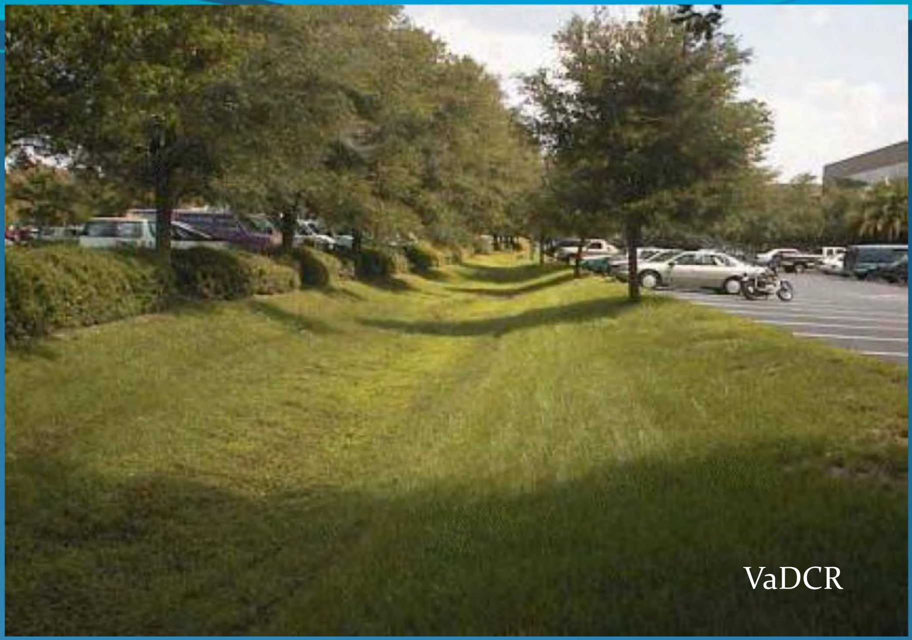
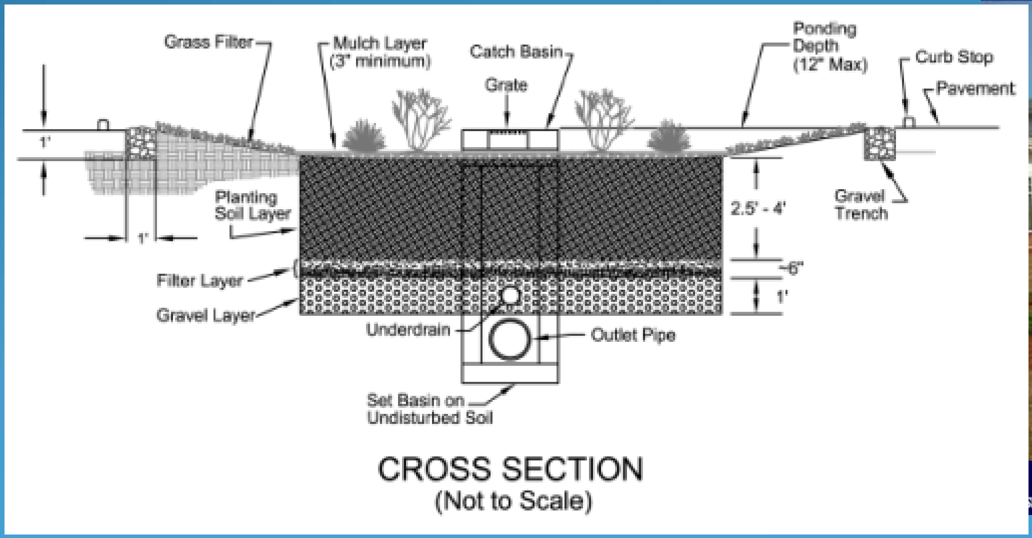
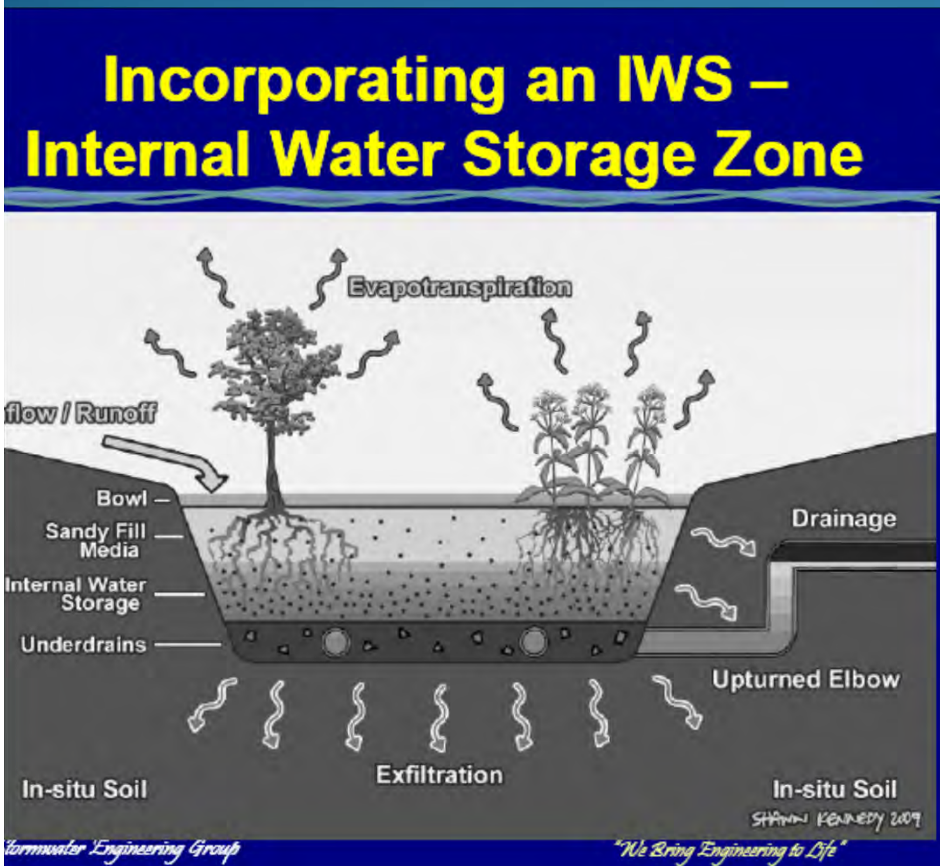




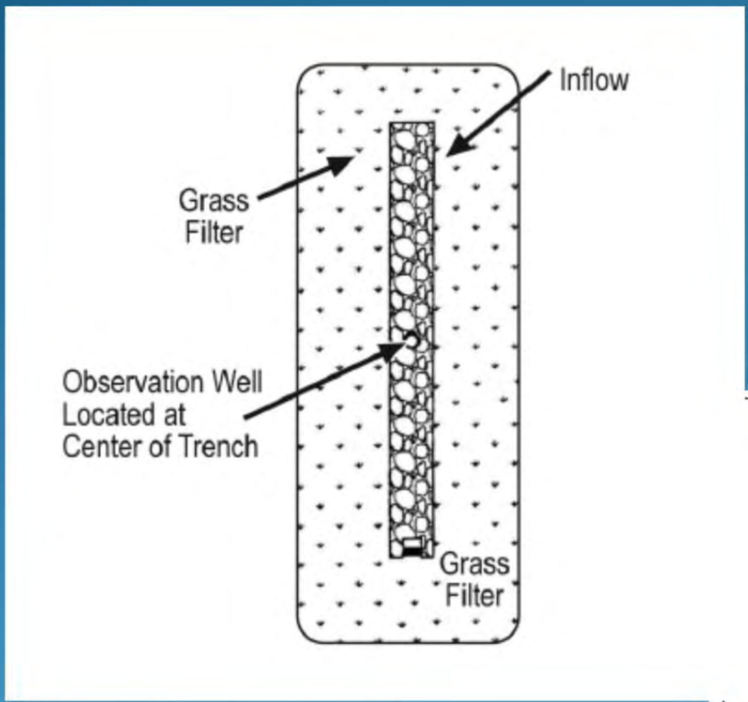
Retention BMPs
6-10. Outlet Configuration



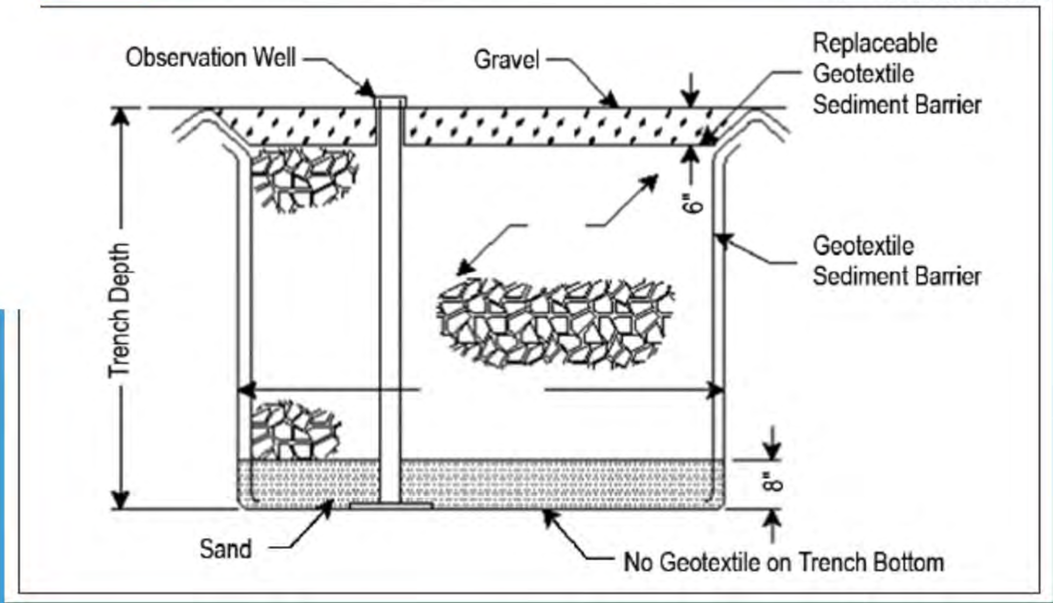
7. Infiltration Trenches and Basins

- Deep aggregate basin, usually w/underdrain
- Treatment mechanism – sedimentation, filtration, infiltration/retention
- How well it works?
  - Retention potential – high to very high
  - Peak attenuation – medium to high
- How much is known about the hydrologic performance of this BMP – medium to high
- What else do we need to know for modeling? Ohio data

7. Infiltration Trenches & Basins



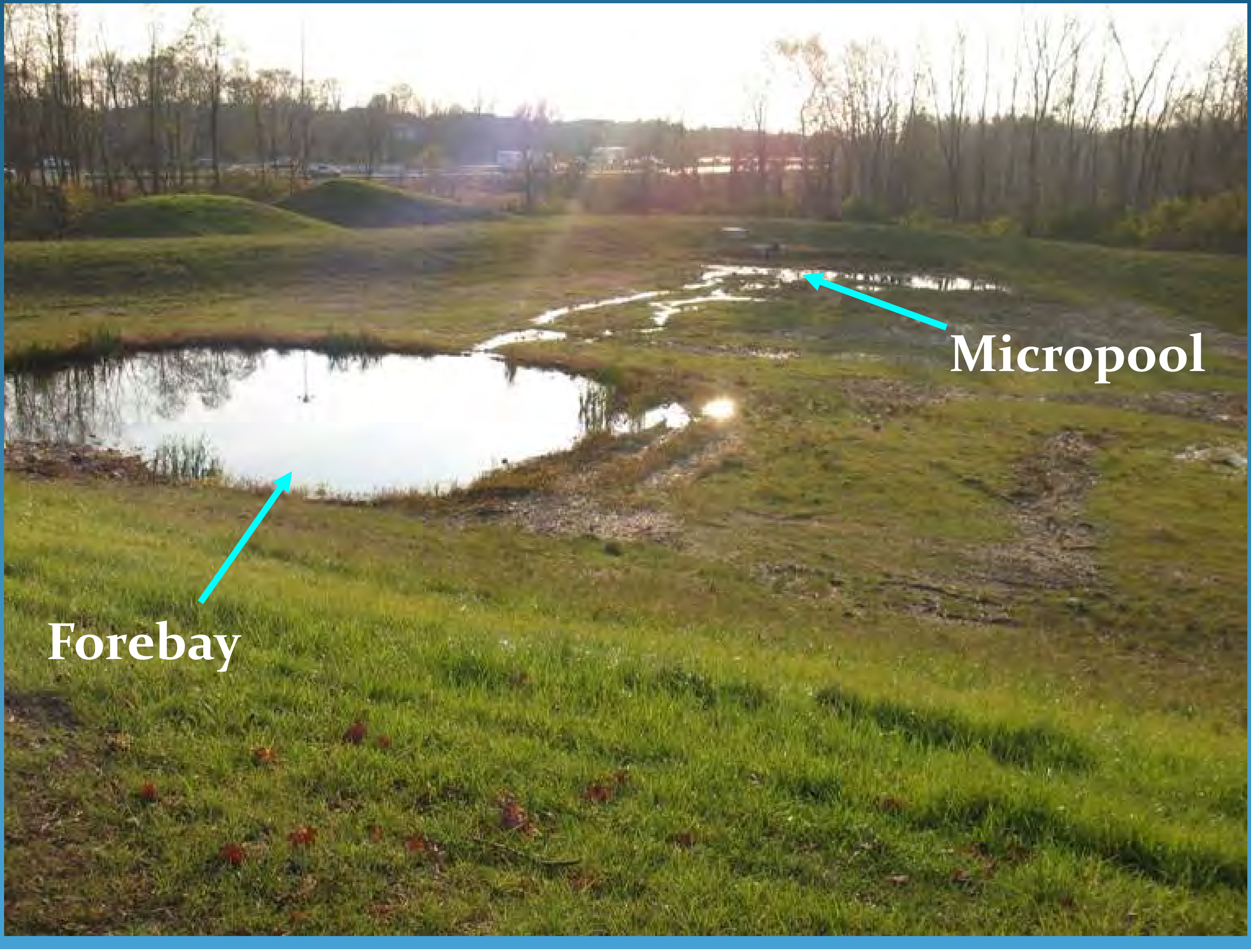
S. Sonnenberg



8. Dry Detention/Retention Basins

- Deep open-surfaced basin; performance can be enhanced w/underdrain
- Treatment mechanism – sedimentation, infiltration/retention
- How well it works?
  - Retention potential – low to high
  - Peak attenuation – medium to high
- How much is known about the hydrologic performance of this BMP – medium to high
- What else do we need to know for modeling? Design guidance for enhanced performance, data based on enhanced design

Dry Pond - Forebay & Micropool



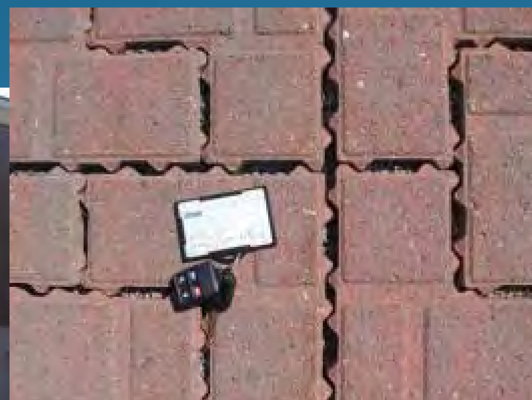
8. Dry Basins

8. Dry Basins

9. Pervious Pavement

- Aggregate basin under permeable pavement surface, usually w/underdrain
- Treatment mechanism – sedimentation, filtration, infiltration/retention
- How well it works?
  - Retention potential – high to very high
  - Peak attenuation – high to very high
- How much is known about the hydrologic performance of this BMP – high
- What else do we need to know for modeling? Ohio data

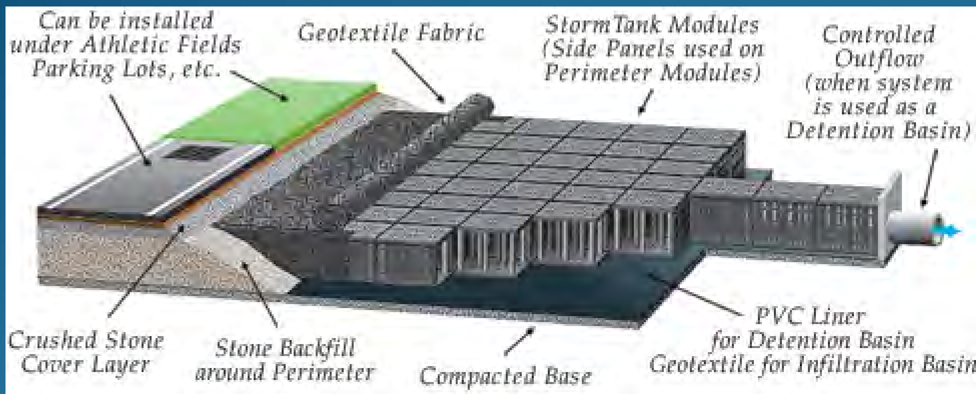
9. Pervious Pavement



10. Underground Retention/Detention

- Underground basin (open and/or aggregate) under pavement surface
- Treatment mechanism – sedimentation, infiltration/retention
- How well it works?
  - Retention potential – high to very high
  - Peak attenuation – high to very high
- How much is known about the hydrologic performance of this BMP – medium to high
- What else do we need to know for modeling? Data on infiltration potential

10. Underground Retention/Detention



11. Wet Detention Basins Including Wet Ponds and Wetlands

- Surface basin with permanent pool
- Treatment mechanism – sedimentation
- How well it works?
  - Retention potential – low
  - Peak attenuation – high
- How much is known about the hydrologic performance of this BMP – high
- What else do we need to know for modeling? Not much

12. Subsurface Gravel Wetland

- Underground aggregate-filled basin
- Treatment mechanism – sedimentation, filtration, biologically-mediated processes
- How well it works?
  - Retention potential – low
  - Peak attenuation – low to medium
- How much is known about the hydrologic performance of this BMP – low to medium
- What else do we need to know for modeling? Data on hydrologic performance, guidance for Ohio

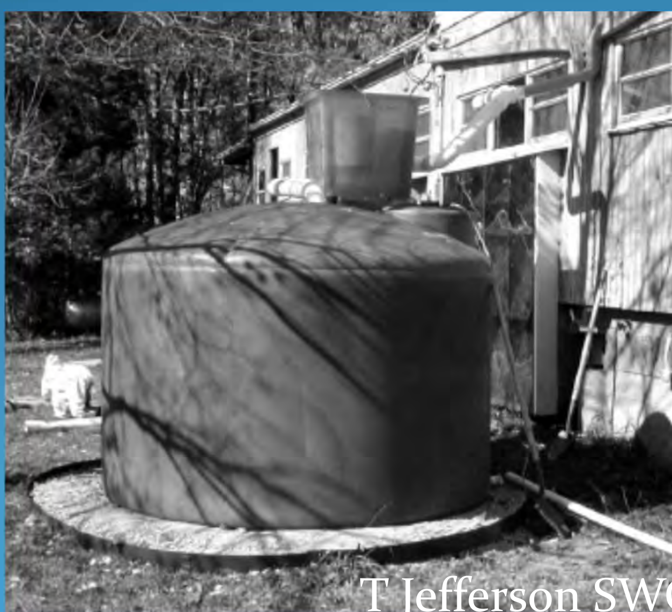
13. Rainwater Harvesting

- Capturing and using (or slowly releasing) in a tank
- Treatment mechanism – sedimentation, runoff volume reduction
- How well it works?
  - Retention – low
  - Peak attenuation – low
- How much is known about the hydrologic performance of this BMP – high
- What else do we need to know for modeling? Case examples where use has been documented

13. Rainwater Harvesting


T Jefferson SWCD, VA


T Jefferson SWCD, VA


T Jefferson SWCD, VA


T Jefferson SWCD,

Discussion

What 3 types of BMPs are most important to monitor and model in this project?

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1. Soil quality preservation/renovation
2. Disconnection
3. Grassed/vegetated filter strips
4. Water quality swales (several variations)
5. Green roofs
6. Bioretention (including dry swales and tree boxes)
7. Pervious pavements
8. Underground detention/retention (with and without infiltration)
9. Dry detention (retention) basins
10. Infiltration (retention) basins and trenches
11. Wet ponds and wetland basins
12. Subsurface gravel wetlands
13. Cisterns/rainwater harvesting
14. Others?

Criteria for Site Selection

Project Monitoring Requirements

Essential criteria for any monitoring site under this project

- Timing of construction
- Ohio Lake Erie Basin between Pipe Creek and Chagrin River, with priority for targeted watersheds Chagrin River, Old Woman Creek, Pipe Creek
- Availability of design specifications
- Ability to monitor or retrofit – "monitorability", physical structure allows for monitoring equipment to measure flow in and out of BMP

What Other Considerations Should Influence Site Selection

- Size and scale of BMP
- What BMP was designed to treat
- Availability of construction and maintenance costs, maintenance plans
- Size of drainage area to BMP
- Others?

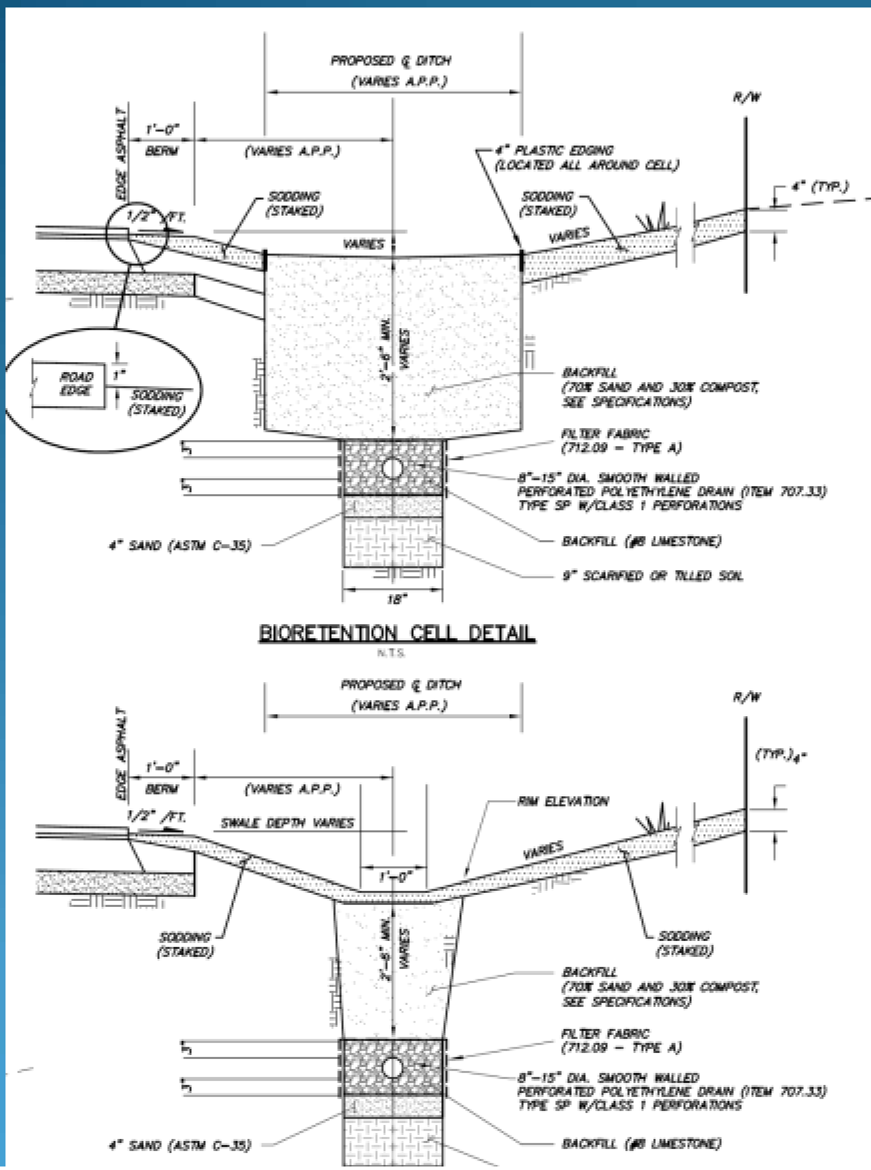
Possible Monitoring Locations

Cawrse and Associates Pervious Pavers

- USGS monitoring hydrology 2009 through 2012

Sterncrest Bioretention

- USGS monitoring hydrology 2008 through 2012



Mayfield Heights SWIF Grant

- Porous Concrete – 3,380 sq. ft.
- Rain Garden/Bioretention
- Completed by URS
- Completed July 2011


MAYFIELD HEIGHTS
MUNICIPAL COMPLEX
28 PARK&REC 7:00
4 CITY HALL CLOSED

Eastlake SWIF Grant

- 2 Bioretention Cells – 2,700 ft^2 at Eastlake Service Facility
- Design Completed by CT Consultants
- Completed September 2011

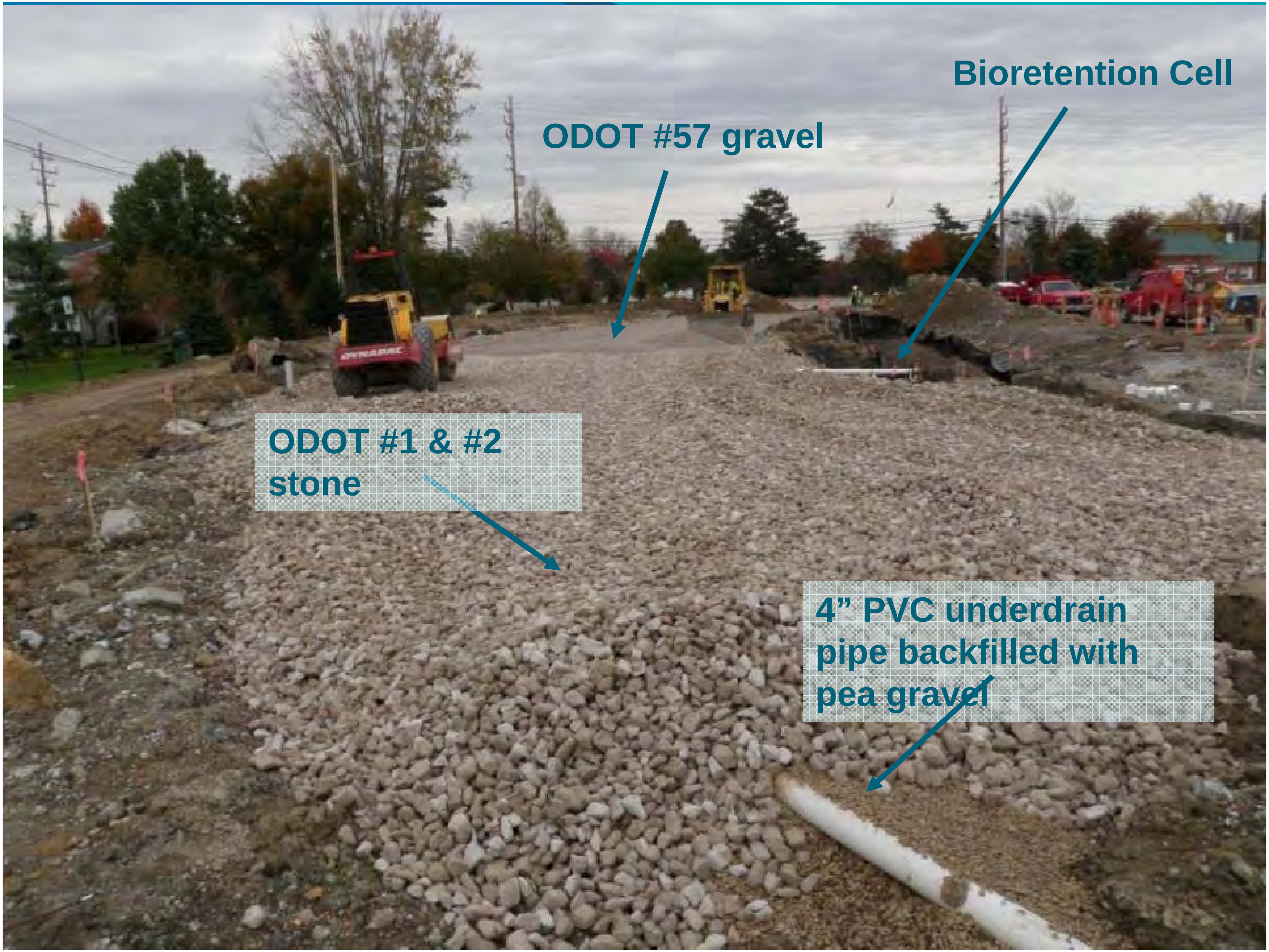
Eastlake Bioretention SWIF Project

Moreland Hills Bioretention

- Treat first ¾" of rainfall from Service Department roof and a portion of parking lot
- Design by Chagrin Valley Engineering
- Partially funded by NEORSD
- Constructed 2010
- Include 4 inch under drain, 2 foot box, engineered soil mix
- Built on C Soils

Wiley Park 319 Mayfield Village

- Bioretention Cell – 650 square feet
- Pervious Pavers Parking Area – 8,000 square feet
- Design completed by Stephen Hovancsek & Associates, Inc.
- Constructed November 2011, Planting of bioretention to be in Spring 2012


Bioretention Cell
ODOT #57 gravel
ODOT #1 & #2 stone
4” PVC underdrain pipe backfilled with pea gravel

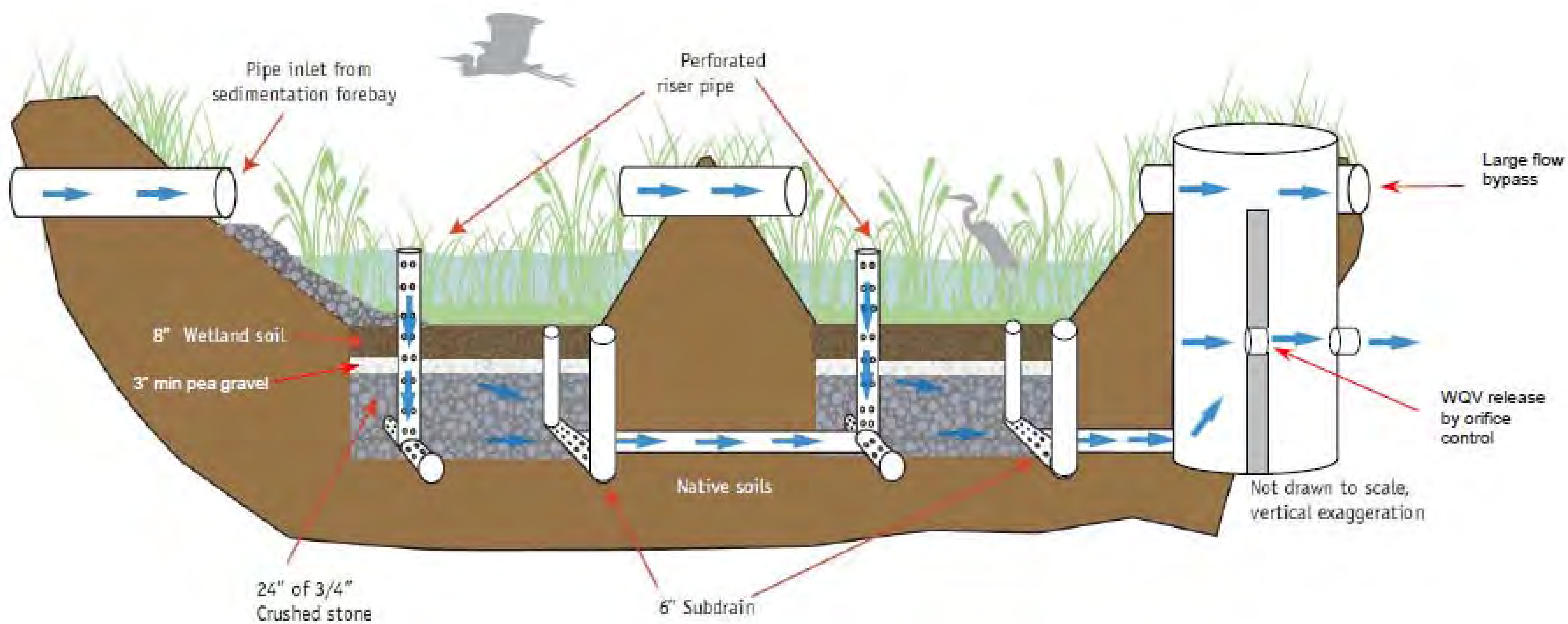

Bioretention cell
Rolled curb cuts

Chester Township SWIF Grant

- 3 Bioretention Cells – 1,300 sq. ft.
- Pervious Paver Parking Area – 3,806 sq. ft.
- Design completed by Land Design Consultants, Inc.
- Scheduled construction – Spring 2012

Concord Township: Gravel Wetland

- First gravel wetland constructed in Northeast Ohio
- Design by Chagrin Valley Engineering
- Construction completed November 2011



Cleveland State University Green Roof

- 7,000 square foot roof top green roof on Recreation Center
- Constructed in August 2009

City Centre Avon

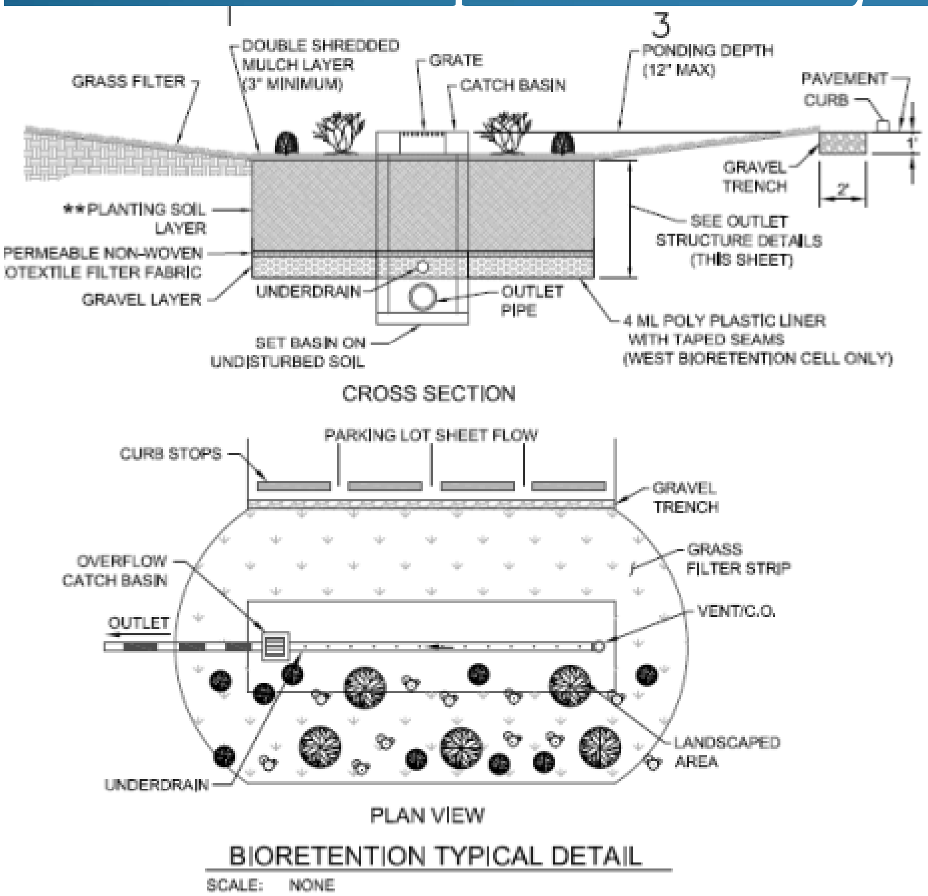
- Bioretention, sand filter and wet extended detention basin

Sheetz Gas Stations

- GPD Group has designed several stations stormwater management
- Bioretention and underground detention
- Twinsburg and Parma

Seven Hills City Hall

- 2 bioretention cells: one is lined with rainwater capture
- Pervious paver walkway

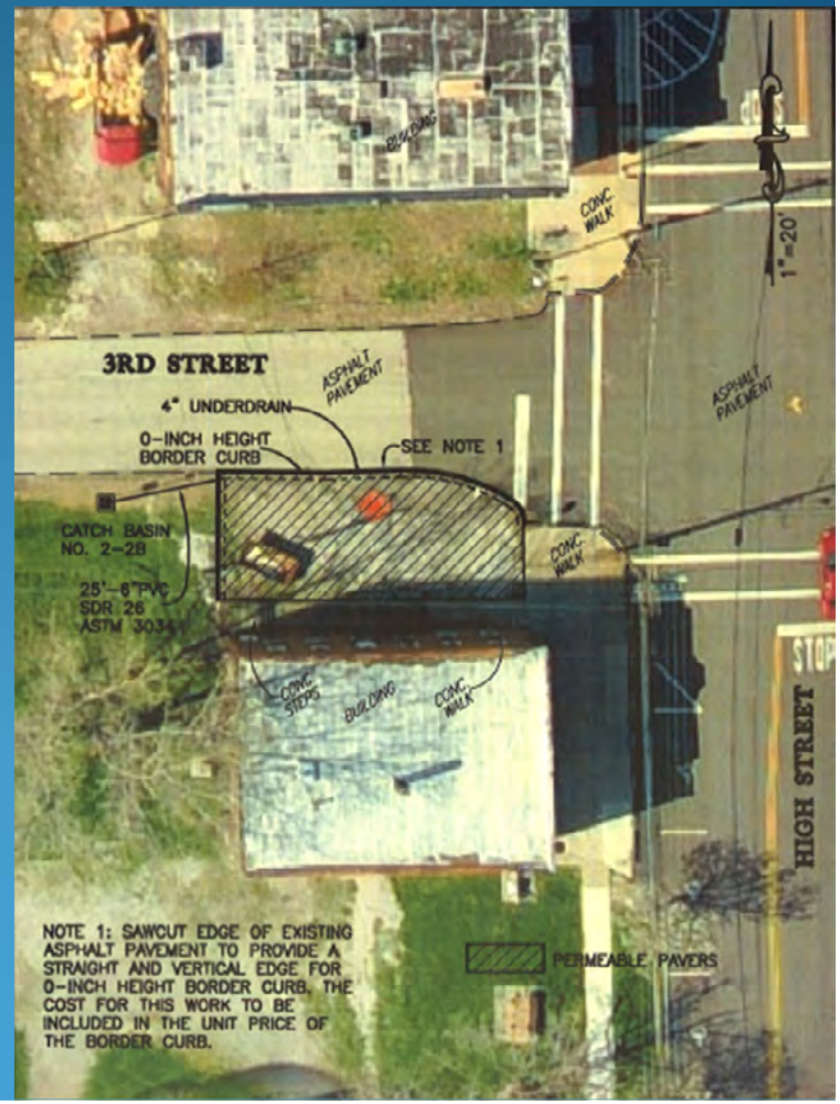


Tremont Bioretention

- Designed by URS for Tremont West Development Corporation to redesign a proposed public/private parking lot with bioswales and pervious pavements.
- 8' wide bioswale that captures runoff from the parking bays (0.46 acres) and infiltrates to sandy soil beach ridge.
- Designed to infiltrate 2 year storm and reduce overall peak discharges for other storm events by 44%.

Fairport Harbor Pervious Pavers and Concrete

- Fairport Harbor and Lake County Storm Water Department
- Side by side pervious paver verses pervious concrete demonstration project for on-street parking areas.
- 1,450 sq. ft. of conversion for each pervious pavement application.
- Design completed by CT Consultants, possible SWIF project.



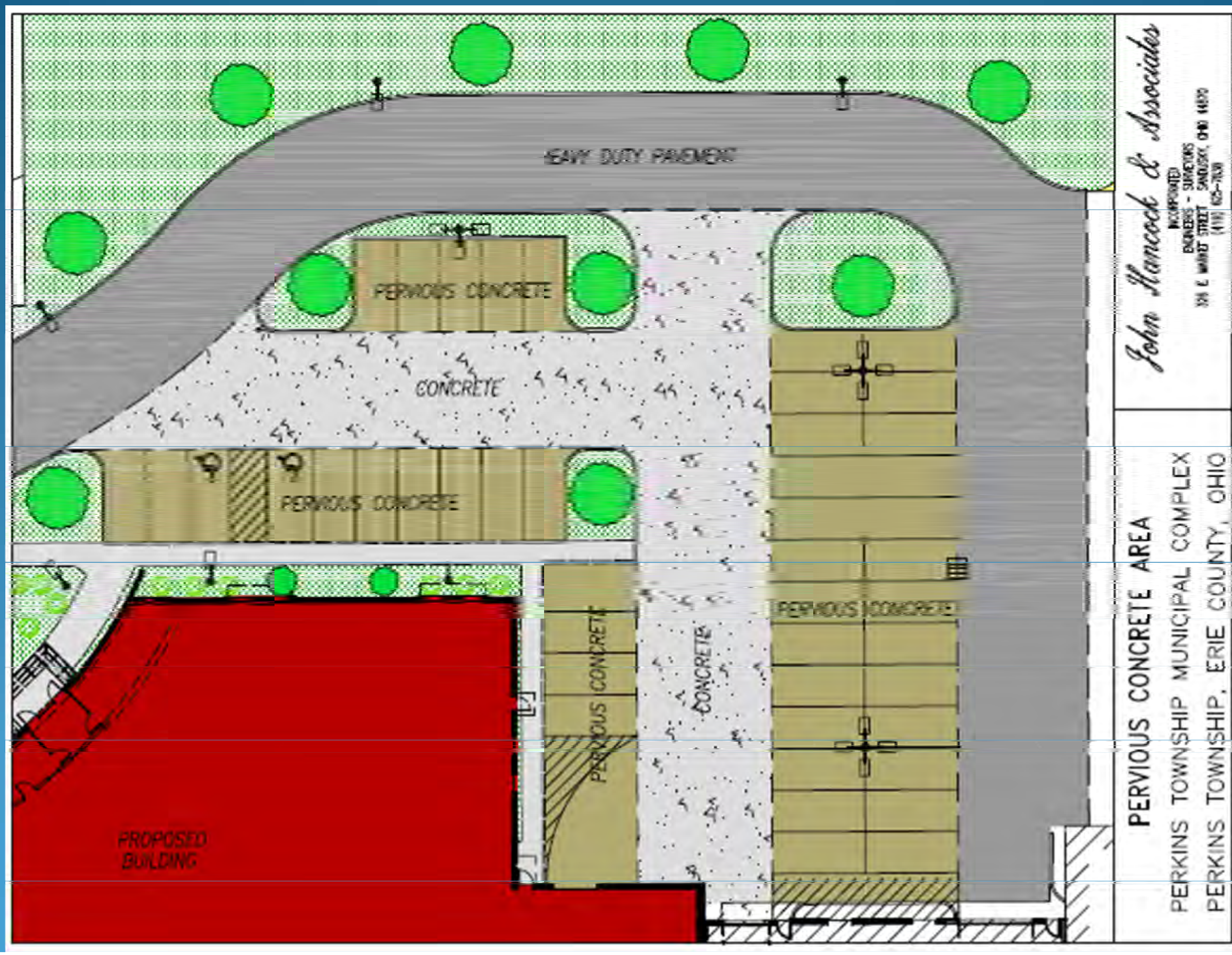
Cleveland Metroparks West Creek Center

- Parma, Ohio
- New center has numerous BMPs to sample including stormwater wetlands, bioretention, and pervious pavers.
- Building under construction with stormwater BMP installation planned for 2012.
- Designed by Floyd Browne.
- All BMPs have their own drainage areas and should be set up to allow monitoring

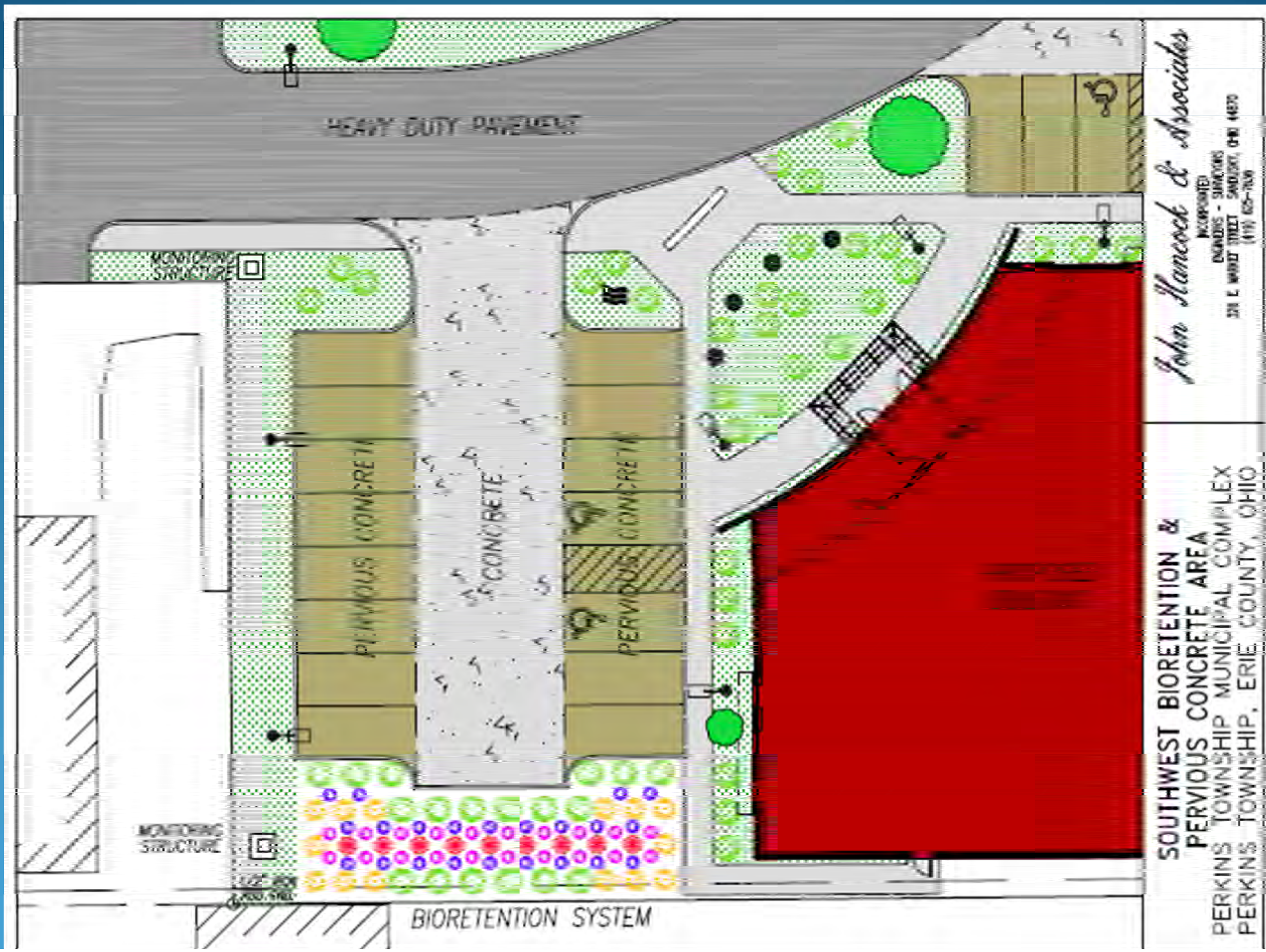
Perkins Township Administration Building

- Perkins Township offices are relocating to an abandoned commercial strip plaza and is currently developing site plans to remove portions of parking and install a series of LID stormwater BMPs.
- Proposed BMPs include:
  - Pervious Concrete
  - Bioretention

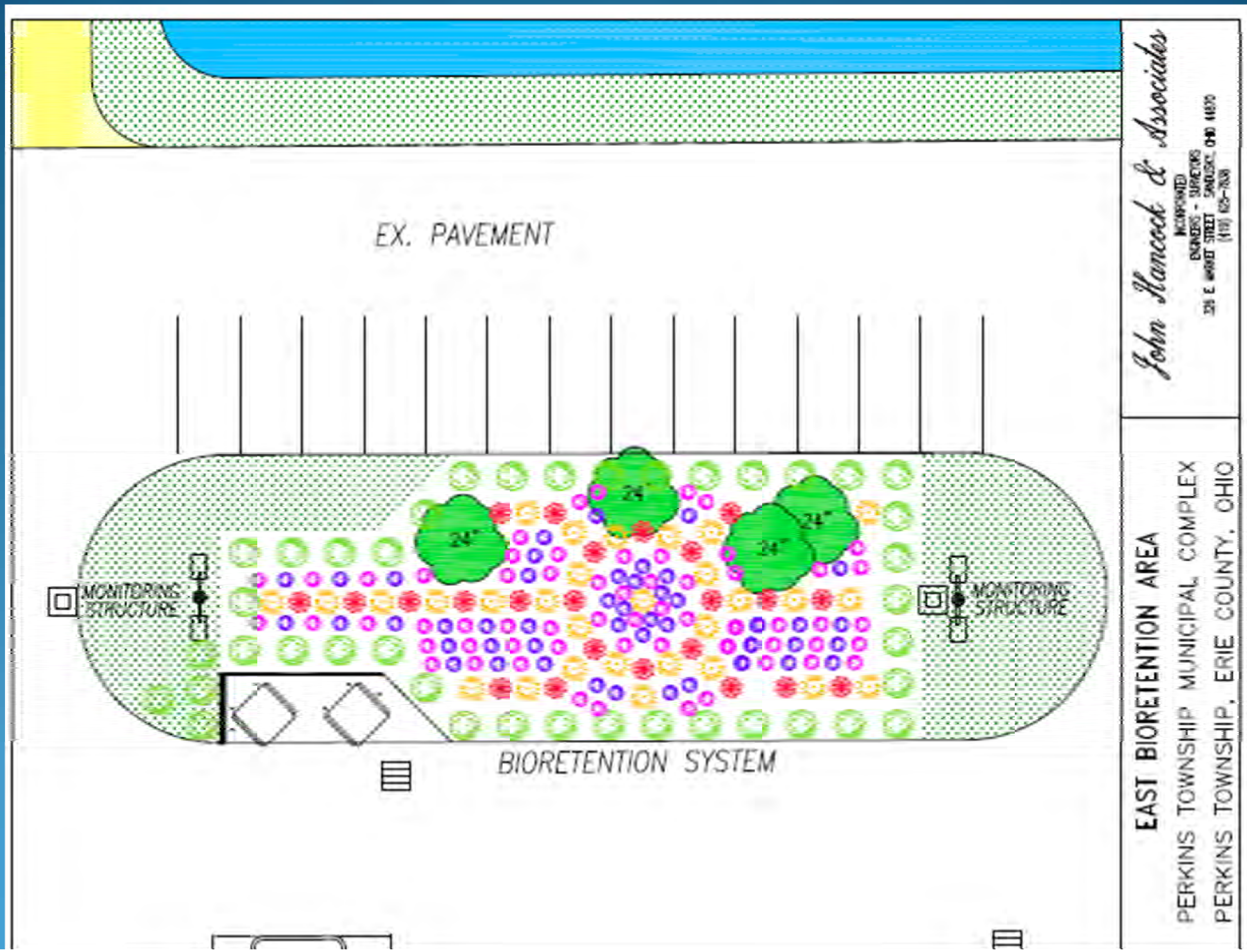
Perkins Township Administration Building



Perkins Township Administration Building



Perkins Township Administration Building



Ritter Library

- Vermilion, Ohio
- Constructed in 2009

Vermilion Library

Discussion of Potential Sites

- What are your reactions to these sites?
- Any specific sites that are appealing to monitor?
- Pros and Cons?
- Other potential projects?

Collaboration Learning Group Business

Benefits and Expectations for CLG Member

- Benefits
  - Professional development and CEUs
  - Design assistance
  - Possible monitoring of your sites
  - Site visits
  - Limited compensation available
- Expectations
  - Attend quarterly CLG meetings
  - Be responsive to project team requests
  - Attend Collaboration Training in April
  - Read and review project materials, including modeling assumptions, draft tools, etc.

CLG Business Meeting

- Membership and Operations
- Meeting Frequency and Location
- Collaborative Research Training Opportunity

Amy H. Brennan
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Next Steps

Monitorability

P – Precipitation (Rainfall & Snowmelt)

ET – Evaporation & Transpiration

S1 – Temporary Surface Storage

S2 – Temporary Subsurface Storage

F1 – Infiltration

F2 – Exfiltration

Qin – Runon/Lateral Inflow

Qout - Runoff